

Soils normally contain low background levels of heavy metals. However, in areas where agricultural, industrial or municipal wastes are land-applied as fertilizer, concentrations may be higher. Excessive levels of heavy metals can be hazardous to man, animals and plants.

By definition, a heavy metal has a specific gravity of about 5.0 or greater and is usually poisonous. The term heavy metal, however, is often broadly applied to include other potentially hazardous elements, even if they do not meet the strict chemical definition. The N.C. Department of Environment and Natural Resources (NCDENR) regulates levels of the “heavy metals” arsenic (**As**), cadmium (**Cd**), chromium (**Cr**), lead (**Pb**), nickel (**Ni**) and selenium (**Se**) on waste application sites.

Agricultural, industrial and municipal wastes can only be applied to sites permitted by NCDENR. This process requires a soil test to establish baseline levels of the regulated heavy metals. Permit renewal requires additional testing—usually every five years and possibly at more frequent intervals—to assess heavy metal accumulation in the soil.

Heavy metals soil tests are conducted by the NCDA&CS Agronomic Division from April through December for a fee of \$25 per sample. The Mehlich-3 extractant is used to measure levels of arsenic, cadmium, chromium, lead, nickel and selenium, according to NCDENR regulations. Measurements for copper and zinc—two heavy metals that are essential plant nutrients—are also provided on the routine soil fertility report that accompanies each heavy metals report.

Here is some background information—natural occurrence, industrial uses, degree of hazard and likelihood of accumulation in the soil—for each heavy metal measured by NCDA&CS. Table 1 lists average concentrations from land-application sites in our state.

■ Arsenic (As)

Natural Occurrence: As occurs naturally in the mineral mispickel or arsenopyrite. Occasional deposits of elemental As are found, but for the most part, it is a by-product of the commercial treatment of ores of other metals. The U.S. is the largest commercial producer of As. All As compounds are poisonous.

Uses: Component in manufacture of bronze materials, fireworks, shot, agricultural chemicals, laser materials,

glass, semiconductor materials, wood preservatives, copper and lead alloys and insecticides (most of which are obsolete)

Notes: In North Carolina, **As** levels in groundwater are insignificant.

■ Cadmium (Cd)

Natural Occurrence: Greenockite is the only mineral of any consequence that contains Cd. Although Cd does occur in small quantities within zinc ores such as sphalerite, there are no notable occurrences of these minerals in North Carolina.

Uses: Component in manufacture of solder, electrical supplies, batteries, barriers to control nuclear fission, phosphors in the production of televisions, anticorrosive coatings for metals, bearing alloys, amalgam in dentistry and worm treatments for swine and poultry

Notes: Sewage sludge containing **Cd** and other heavy metals is frequently applied to agricultural land as a fertilizer material.

Regular consumption of plants containing 3.0 ppm **Cd** can poison man and animals. It interferes with enzymes and other proteins. In livestock, it accumulates in the kidneys, spleen and liver.

In humans, **Cd** interferes with the metabolism of calcium and phosphorus, causing a painful bone disease.

Table 1. Average concentrations in North Carolina soil samples analyzed for heavy metals (2005–07)*	
Heavy Metal	parts per million
As	4.5
Cd	0.1
Cr	0.2
Cu	9.2
Pb	4.2
Ni	0.8
Se	0.2
Zn	27.2

* Based on NCDA&CS analysis (using Mehlich-3 extractant) of 3,286 soil samples from various sites where tests for heavy metals were requested

■ Chromium (Cr)

Natural Occurrence: Chromite, the principal ore, occurs in some mines in North Carolina.

Uses: Component in manufacture of steel, stainless steel, alloys, metal plating for prevention of corrosion, coloring agents for emerald green glass, chemical analysis, leather tanning, textile color pigments and mordants, and trace minerals essential to the nutrition of man and animals

Notes: **Cr** functions in mammalian glucose metabolism and appears to be essential to man and animals.

■ Lead (Pb)

Natural Occurrence: Rare in nature, Pb occurs in the minerals anglesite, cerrussite, minimis and galena. It is usually obtained from galena by a roasting process.

Uses: Component in manufacture of older paints, older plumbing hardware, ammunition, solder, metals, storage batteries, sound and vibration absorbers, lead gasoline, obsolete insecticides (lead arsenate), lead crystal and flint glass

Notes: **Pb** can cause health problems, particularly in children. It accumulates in the body and can build to toxic levels under continuous exposure. Concerns about **Pb** poisoning resulted in the elimination of **Pb** from gasoline, paint and plumbing lines.

■ Nickel (Ni)

Natural Occurrence: **Ni** is a constituent of most meteorites, and its presence is one of the criteria used for identifying them. Iron meteorites or siderites may contain from 5 to nearly 20 percent **Ni**. It is obtained commercially from pentlandite found in the Sudbury region of Ontario, which produces 30 percent of the world’s supply.

Uses: Component in manufacture of stainless steel, other corrosion-resistant alloys, coins, nickel steel for armor plates, burglarproof vaults, vegetable oils, ceramics and greenish glass, **Al-Ni-Co** magnets and **Ni-Cd** batteries

Notes: Plants containing more than 100 ppm **Ni** develop symptoms of toxicity. Toxicity in grasses or other monocots closely resembles iron deficiency,